We claim:

1. A method of forming a silicon-germanium layer on an insulator, comprising:

preparing a silicon substrate;

depositing a layer of silicon-germanium on the silicon substrate to form a silicon/silicon-germanium portion having a SiGe/silicon interface;

implanting hydrogen ions into the silicon substrate between about 200Å to 1 μm below the silicon-germanium/silicon interface;

preparing an insulator substrate;

bonding the silicon/silicon-germanium portion to the insulator substrate with the silicon-germanium layer in contact with the insulator substrate to form a couplet;

thermally annealing the couplet in a first thermal annealing step to split the couplet into a silicon portion and a silicon-germanium-on-insulator portion;

patterning and etching the silicon-germanium-on-insulator portion to remove portions of the silicon and SiGe layers;

etching the silicon-germanium-on-insulator portion to remove the remaining silicon layer;

thermally annealing the silicon-germanium-on-insulator portion in a second annealing step to relaxed the SiGe layer; and

depositing a layer of strained silicon about the SiGe layer.

2. The method of claim 1 which further includes depositing an epitaxial silicon layer on the hydrogen-implanted silicon germanium layer before said bonding; and removing the silicon germanium layer from the silicon-germanium-on-insulator portion after said second thermal annealing to form a relaxed silicon-on-insulator portion.

3. The method of claim 1wherein said preparing an insulator substrate includes preparing a silicon oxide-on-silicon substrate.

4. The method of claim 1 wherein said depositing a layer of silicon-germanium on the silicon substrate includes depositing a layer of silicon-germanium to a thickness of between about 20 nm to 100 nm at a germanium concentration of between about 10% to 60%, and wherein the germanium concentration is distributed in the layer taken from the group of distributions consisting of uniform distribution and graded distribution.

5. The method of claim 1 wherein said implanting hydrogen ions in the silicon-germanium layer includes implanting hydrogen ions taken from the group of hydrogen ions consisting of H^+ ions and H_2^+ ions, at an ion does of between about $1 \cdot 10^{16}$ cm^{-2} and $5 \cdot 10^{17}$ cm^{-2} at an energy of between about 1 keV to 300 keV.

6. The method of claim 5 which includes implanting ions taken from the group of ions consisting of hydrogen, argon, helium and boron.

7. The method of claim 1 wherein said bonding the silicon/silicon-germanium portion to the insulator substrate with the silicon-germanium layer in contact with the insulator substrate to form a bonded entity includes bonding by direct wafer bonding.

8. The method of claim 1 wherein said curing the bonded entity includes curing the bonded entity at a temperature of between about 150°C to 250°C for a time of between about one hours to fourteen hours.

9. The method of claim 1 wherein said thermally annealing the bonded entity includes annealing the bonded entity at a temperature of between about 350°C to 700°C for a time of between about thirty minutes to four hours.

10. The method of claim 1 wherein said second thermal annealing includes thermal annealing at a temperature of between about 600°C to 900°C, for between about ten minutes to sixty minutes in an inert atmosphere.

11. The method of claim 1 wherein said depositing a layer of strained silicon includes depositing strained silicon to a thickness of between about 10 nm to 30 nm by a deposition technique taken from the group of deposition techniques consisting of CVD and molecular beam epitaxy at a temperature on a range of between about 450°C to 800°C.

12. A method of forming a silicon-germanium layer on a silicon oxide-on-silicon substrate, comprising:

preparing a silicon substrate;

depositing a layer of silicon-germanium on the silicon substrate to form a silicon/silicon-germanium portion having a SiGe/silicon interface;

implanting hydrogen ions into the silicon substrate between about 200Å to 1 μm below the silicon-germanium/silicon interface;

preparing a silicon oxide-on-silicon substrate;

bonding the silicon/silicon-germanium portion to the silicon oxide-on-silicon substrate by direct wafer bonding with the silicon-germanium layer in contact with the silicon oxide to form a couplet;

thermally annealing the couplet in a first thermal annealing step at a temperature of between about 350°C to 700°C for a time of between about 30 minutes to four hours to split the bonded entity into a silicon portion and a silicon-germanium-on-oxide portion;

patterning and etching the silicon-germanium-on-oxide portion to remove portions of the silicon and SiGe layers;

etching the silicon-germanium-on-oxide portion to remove the remaining silicon layer;

thermally annealing the silicon-germanium-on-oxide portion in a second thermal annealing step to relaxed the SiGe layer; and

depositing a layer of strained silicon about the SiGe layer.

13. The method of claim 12 which further includes depositing an epitaxial silicon layer on the hydrogen-implanted silicon germanium layer before said bonding; and removing the silicon germanium layer from the silicon-germanium-on-oxide portion after said second thermal annealing to form a relaxed silicon-on-oxide portion.

14. The method of claim 12 wherein said depositing a layer of silicon-germanium on the silicon substrate includes depositing a layer of silicon-germanium to a thickness of between about 20 nm to 100 nm in biaxial compression strain form at a germanium concentration of between about 10% to 60%, and wherein the germanium concentration is distributed in the layer taken from the group of distributions consisting of uniform distribution and graded distribution.

15. The method of claim 12 wherein said implanting hydrogen ions in the silicon-germanium layer includes implanting hydrogen ions taken from the group of hydrogen ions consisting of H^+ ions and H_2^+ ions, at an ion does of between about $1 \cdot 10^{16}$ cm^{-2} and $5 \cdot 10^{17}$ cm^{-2} at an energy of between about 1 keV to 300 keV.

16. The method of claim 15 which includes implanting ions taken from the group of ions consisting of hydrogen, argon, helium and boron.

17. The method of claim 12 wherein said second thermal annealing includes thermal annealing at a temperature of between about 600°C to 900°C, for between about ten minutes to sixty minutes in an inert atmosphere.

18. The method of claim 12 wherein said depositing a layer of strained silicon includes depositing strained silicon to a thickness of between about 10 nm to 30 nm by a deposition technique taken from the group of deposition techniques consisting of CVD and molecular beam epitaxy at a temperature on a range of between about 450°C to 800°C.